FAX FAX FAX FAX FAX

TO: Gary Broetzman, C/O Animas Stakeholder Group

FROM: Camille Farrell

DATE: April 13, 1995

RE: Appendage to the DRAFT Animas Discovery Report

Hi All!

Attached, please find the newest section to be incorporated into the DRAFT Animas Discovry Report for distribution to the Animas Stakeholders.

Please note that the "Lab Data Validation " section of the report, as well as the CDPHE information provided in TABLE III, is currently being reviewd by CDPHE labs to confirm its validity.

Hope all is well.

See You on the 21st!

3.0 BACKGROUND

The Animas River is located in southwest Colorado in San Juan and La Plata counties. The headwaters of the Animas River and portions of Cement and Mineral Creeks, tributaries of the Animas River, are located within the Silverton caldera, an extensively mineralized area that has been mined for base and precious metals since the late 1800's. The Colorado Division of Minerals and Geology has documented 316 acres of land disturbed by mining in this region, and has located 307 mine openings, 78 of which were actively draining. The last active mine in the area, the Sunnyside Mine, is conducting reclamation pursuant to its Mined Land Reclamation Permit.

4.0 EVALUATION OF EXISTING ANIMAS BASIN DATA

Between 1991 and 1993, the CDPHE Water Quality Control Division, in cooperation with several federal and state agencies, as well as private and local interests, conducted an intensive water quality and biological investigation of the Animas River and its tributaries, from its headwaters to Elk Creek, located approximately 3 miles south of Silverton (Figure 1).

4.1 Study Objectives

The objectives of the study were:

1) to characterize the chemical, biological and physical conditions of the Animas River and selected tributaries above Elk Creek;
2) to quantify areas of highest metal loadings;
3) to determine the potential for water quality improvement sufficient to allow naturally reproducing trout populations; and,
4) to prioritize sites for remedial projects based on relative loadings, environmental impact, feasibility, cost and benefits.

Results and findings of the study are presented in Section 5.0.

4.2 Sample Types and Locations

Water quality samlples were collected at 167 locations during the June, 1991 high-flow event and at 121 locations druing the July, 1992 high-flow event. Samples were collected at 103 locations during one low-flow event (October, 1992) and at 188 locations during one rain-storm event (September, 1991). Biological sampling of fish and macrobenthos occurred in approximatley 25 stream reaches within the basin study area. Figure 1 illustrates the sample site locations. Water quality analytical results of the CDPHE Animas River Basin Study are presented in Appendix A.

Background surface water samples were taken at the head of the various tributaries sampled (CDPHE Sample site locations A19, A23, A39, CO1, CO8, C11, C15, M1, and M8) as well as above apparent sources. **Surface water** samples were also collected above and below sources to quantify impacts to the receiving streams. **Sediment** samples were not collected. Bear Creek (M-30) and Boulder Creek (A62), from which drinking water is supplied to the town of Silverton, were sampled immediately above their confluence with Mineral Creek and the Animas River, respectively.

Source sampling included approximatley 50 draining mine adits, seeps from mine waste piles, and naturally occurring seeps. Table I presents the list of draining mine adits and their location in the basin. Solid source sampling,i.e., mine waste piles including tailings, and waste rock, is scheduled for future site characterization work. Mineral Creek and its triburaries will be "characterized", i.e., collection of qualitative and quantitative site information and sampling, similar to EPA's Preliminary Assessment and Site Investigation programs, by the CDPHE and the Colorado Division of Minerals and Geology during the summer of 1995. "Site Characterization" of sites in other tributaries are scheduled pursuant to the Animas Stakeholders Group prioritzation. Please refer to Section 6.1.1 and Figure 7 for further discussion.

Ground water was not sampled. Groundwater use for drinking water is minimal within a four mile radius of Silverton. Five wells are listed on the Colorado State Engineer's well permit list as household or domestic use wells, within a four-mile radius of Silverton (CDH, 1994). The majority of the population within the basin study area live in Silverton, with few households on the lower reaches of Cement and Mineral Creeks.

On-Site soils and **air** were not sampled. There are few people living or working beyond the town limits of Silverton within the Basin study area. Reclamation is ongoing druing summer and early fall months at the Sunnyside mine, located in Cement Creek, Eureka Gulch and along the mainstem of the Animas near the Mayflower mill, as weather permits. MRRC is also conducting seasonal reclamation on thier properties located in Placer Gulch. Please refer to Sections 6.1.5 and 6.1.14 for further information.

4.3 Field and Laboratory Paramters, Analytical Methods and Quality Assurance/Quality Control Provisions

Tables II and III compare the existing CDPHE data to EPA requiremntents to determine if the exising data can serve in evaluating the site under the Hazard Ranking System (HRS) and prioritizing the site (EPA, 1992; EPA, 1994).

4.3.1 Sampling Mehtods

As approved by the EPA, all CDPHE samples were handled and preserved as described in the CDPHE Standard Operating Procedures (SOP) document (CDH, 1988). Calibration and operation of all monitoring equipment followed the instrument manufacturer's instructions. Each water sample for total metals was acidified to a pH of 2 with nitric acid as a preservative. Each water sample for dissolved metals were filtered in the field, using a 45-micron membrane filter. Measurements of pH, conductivity, and temperature and flow were made and recorded prior to sample collection. Decontamination procedures were adhered to between each sampling event.

Where possible, surface water samples were collected directly into the sampling containers. Sampling progressed from a downstream location to an upstream location to eliminate sediment disturbance in subsequent samples. Surface water samples were collected by immersing the sample bottle several inches beneath the water surface with the mouth of the sample bottle facing upstream. If surface water samples were unable to be collected directly into the sample container, a decontaminated container was used to collecte the sample. Care was taken to avoid excessive agitation when transferring samples to sample containers.

4.3.2 Field QA/QC

CDPHE collected 26 field duplicate samples (1 duplicate per 8 samples collected) during the September, 1991 sampling event. Eleven duplicates (1 per 15 Samples) wwere collected during the June, 1992 sampling event. Six suplicates were collected (1 per 17 samples) during the October, 1992 sampling event and eleven duplicates were collected during the July, 1993 sampling event (1 duplicate per 11 samples). EPA requires that one field duplicate be collected at the rate of 1 duplicate per 20 samples collected.

CDPHE collected 1 filtered field blank per 8 samples collected during the September, 1991 samping event; 1 blank per 15 samples during the June, 1992 sampling event; 1 blank per 26 samples during the October, 1992 sampling event; and, 1 blank per 24 samples during the July, 1993 sampling event. EPA requires that feild blanks be collected using analyte free water at the rate of 1 per day of sampling, at least 1 per 20 samples.

CDPHE collected filtered field blanks which double for equipment rinsate blanks. Thus, the rate of filtered field blanks collected, as listed in the preceding paragraph, correspond to equipmant rinsate blanks. EPA requires that rinsate blanks be collected in the field using analyte-free water from decontaminated equipment as a check for decontamination procedures. Rinsate blanks are required to be collected for each day sampling equipment is decontaminated in the field at the rate of 1 per 20 samples.

4.3.3 Laboratory QA/AC

The CDPHE laboratory analyzes 1 duplicate for every 10 samples collected; EPA requires that one duplicate water sample be collected for every 20 samples to determine accuracy and precision in laboratory analytical procedures as well as sample collection procedures.

CDPHE analyzes 1 spike for every 10 samples analyzed; EPA requires that a sufficient volume of water be collected at the rate of 1 per 20 samples to provide to the lab for matrix spike and matrix spike duplicate analyses for quality control.

CDPHE Lab analytical instruments are standardized daily; reference materials are also used which verify CDPHE standards and checks the accuracy of the lab instruments in use (Alexander, 1995).

4.3.4 Data Validation Requirements

EPA Data Validation Requirements are provided in Appendix B; the CDPHE Laboratory follows the same procedures (Alexander, 1995.)

TABLE I

CDPHE Animas Basin Sampling

Draining Mine Adits - Aqueous Sources

Sampling Location	Site Name	Site Location Description
ANIMAS MAINSTEM AND ITS TRIBUTARIES		
A 02	Lucky Jack Drainage	Upper Animas Headwaters
A 02b	Lucky Jack Adit	Upper Animas Headwaters
A 07 LM	Burrows G.; London Mine	Upper Animas Headwaters
A 07 LMS	Burrows G.; London Mine	Upper Animas Headwaters
A 11a	Columbus Mine	California G.; below confluence with Placer G.
A 12	California Adit	California G.; below confluence with Placer G.
A 17a	California G. Adit	Upper California G.
A 17b	California G. Adit	Upper California G.
A 19a	California G. Adit	Upper California G.
A 21a	Placer Adit	Placer G.
A 23a		Placer G.
A 29	Niagara G. Adit	Tributary south of Burns G.
A 38	Terry Tunnel	Upper Eureka G.
A 49	Cunningham Adit	Cunningham Cr.
A 49a	Cunningham Adit	Cunningham Cr.
A 50	Cunningham Adit	Cunningham Cr.
A 57	Mayflower Pipe	Mainstem of Animas above confluence with Arrastra Cr.
A 63	Animas Adit	Small tributary south of Animas, west of Arrastra Cr.
A 63a	Aspen Adit	Small tributary south of Animas, west of Arrastra Cr.
A 69	Idaho Adit	Idaho G.
A 71	Animas Adit	Small tributary west of Animas, below confluence with Mineral Cr.

TABLE I

CDPHE Animas Basin Sampling

Draining Mine Adits - Aqueous Sources

Sampling Location	Site Name	Site Location Description
CEMENT CREEK AND ITS TRIBUTARIES		
CC 01	Queen Ann Adit	North Fork of Cement Creek Headwaters
CC 01b	Mogul Tunnel	North Fork of Cement Creek Headwaters
CC 01c	Mine Adit Above Mogul Tunnel	North Fork of Cement Creek Headwaters
CC 01d	Mine Adit Above Mogul Tunnel	North Fork of Cement Creek Headwaters
CC 01e	Mine Adit Above Mogul Tunnel	North Fork of Cement Creek Headwaters
CC 01f	Mine Adit Above Mogul Tunnel	North Fork of Cement Creek Headwaters
CC 10	Middle Fork Cement Adit	Middle Fork of Cement Creek Headwaters
CC 14	South Fork Cement Adit	N. trib. of S. Fork of Cement Cr. Headwaters
CC 19	American Tunnel	Cement C. below the confluence with Minnehaha
CC 24a	Prospect Adit	Mainstem of Prospect G.
CC 24b	Prospect Adit	Mainstem of Prospect G.
CC 29	Cement Adit	Trib. west of Cement Cr., below Prospect G.
CC 29a	Cement Adit	Trib. west of Cement Cr., below Prospect G.
CC 32	Cement Adit	Mainstem of Cement Creek
CC 37	Anglo Saxon Adit	Mainstem of Cement Creek
CC 37a	Anglo Saxon Adit	Mainstem of Cement Creek
CC 44	Topeka Adit	Mainstem of Cement Creek
MINERAL CREEK AND ITS TRIBUTARIES		
M 02a	Longfellow/Koehler Complex	Mineral Creek Headwaters
M 02b	Longfellow/Koehler Complex	Mineral Creek Headwaters
M 09	Mill Creek Adit	Upper Mill Creek
M 11a	Adit Below Beaver Ponds	Mainstem of Mineral Creek below Mill Cr.
M 12a	Browns G. Adit	Browns Gulch
M 12b	Browns G. Adit	Browns Gulch
M 21	Bonner Adit	Lower Middle Fork of Mineral Creek
M 21a	Bonner Adit	Lower Middle Fork of Mineral Creek
M 24	Bandora Adit	South Fork of Mineral Creek Headwaters
M 36	Mineral Creek Adit	Mineral Creek before confluence with Animas
M 37	Mineral Adit	Mineral Creek before confluence with Animas

TABLE II

Comparison of CDPHE existing data to EPA HRS Requirements
UPPER ANIMAS FIELD MEASUREMENTS

Sample Location		Field Parameters		Field QA/QC	
CDPHE	EPA	CDPHE	EPA	CDPHE	EPA
Background (water)	Background (water)	Temp.	Temp.	1 Field Blank per 18 samples (average)	1 Field Blank per 20 samples (blind)
Aqueous Sources (draining mine adits; mine waste seeps; natrual seeps)	Aqueous Sources	pH	pH	1 Rinsate Blank per 19 samples (same as filtered field blanks)	1 Rinsate Blank per day (1 per 20 samples)
+++	Solid Sources	EC	EC	Not Applicable	1 Trip Blank per trip (VOA only)
Surface Water	Surface Water	Discharge (High and low flow)		1 Duplicate per 13 samples (average)	1 Duplicate per 20 samples (blind)
	Sediments	Discharge (storm event)			

Field Blank = Quality Control to assess potential field contamination
Rinsate Blank = Quality Control to assess field decontamination procedures
Trip Blank = (For VOC's) Quality Control to assess sample handling/shipping procedures
+++ = Sampling of solid sources scheduled during future 'Site Characterization' of specific sub-basins

TABLE III

Comparison of CDPHE Existing Data to EPA HRS Requirements
UPPER ANIMAS LABORATORY MEASUREMENTS

Analytical Parameters		Analytical Methods (EPA Methods)		Detection Limits(ug/L)		Laboratory QA/AC		Laboratory Data Validation for Inorganics Analyses	
CDPHE	EPA	CDPHE	EPA	CDPHE	EPA CROL	CDPHE	EPA	CDPHE	EPA
Aluminum	Aluminum	200.7; ICP	200.7; ICP	50	200	1 Spike per 10 samples	1 Spike per 20 samples	Holding Times: 6 mo; pH<2; (Hg<28 days)	Holding Times: 6 mo; pH<2; (Hg<28 days)
	Antimony		200.7; ICP 204.2; GFAA		60	1 Instrument Blank per 10 samples	1 Instrument Blank per 20 samples	Calibration: once/day	Calibration: once/day
Arsenic	Arsenic	200.9; HYDRIDE	200.2; GFAA	1	10	1 Duplicate per 10 samples	1 Duplicate per 20 samples	Blanks: No contamination	Blanks: No contamination
	Barium		200.7; ICP		200			ICP Interference Check: 2x/8-hrs	ICP Interference Check: 2x/8-hrs
	Beryllium		200.7; ICP 210.2; GFAA		5			Lab Control Sample: +/- 20%	Lab Control Sample: +/- 20%
Cadmium	Cadmium	200.7; ICP 200.9; GFAA	200.7; ICP 213.2; GFAA	40 0.25	5			Duplicate Sample: +/- 20%	Duplicate Sample: +/- 20%
	Calcium		200.7; ICP		5000			Matrix Spike: +/- 25%	Matrix Spike: +/- 25%
Chromium	Chromium	200.7; ICP 200.9; GFAA	200.7; ICP 218.2; GFAA	10 5	10			Furnace AA QC: spikes = +/- 15%	Furnace AA QC: spikes = +/- 15%
	Cobalt		200.7; ICP		50			ICP Serial Dilution: +/-10%	ICP Serial Dilution: +/-10%
Copper	Copper	200.7; ICP 200.9; GFAA	200.7; ICP	4 5	25			Sample Result Verification	Sample Result Verification
Cyanide	Cyanide	335.1; COLORIMETRIC	335.2	10	10			Field Duplicates	Field Duplicates
Iron	Iron	200.7; ICP	200.7; ICP	10	100			Overall Data Assessment	Overall Data Assessment
Lead	Lead	200.9; GFAA 239.2; GFAA	200.7; ICP 239.2; GFAA	5 5	3				
Magnesium	Magnesium	200.7; ICP	200.7; ICP	1000	5000				
Manganese	Manganese	200.7; ICP	200.7; ICP	4	15				
Mercury	Mercury	245.1; MANUAL COLD VAPOR	245.1; MANUAL COLD VAPOR 245.2; AUTO COLD VAPOR	0.2	0.2				
Nickel	Nickel	200.7; ICP	200.7; ICP	20	40				
	Potassium		200.7; ICP		5000				
Selenium	Selenium	SM3114B; HYDRIDE 270.3; HYDRIDE	270.2; GFAA	11	5				
Silver	Silver	272.2; GFAA 200.9; C FURNACE AA	200.7; ICP 272.2; GFAA	0.2 0.2	10				
	Sodium		200.7; ICP		5000				
	Thallium		200.7; ICP 279.2; GFAA		10				
	Vanadium		200.7; ICP		50				
Zinc	Zinc	200.7; ICP	200.7; ICP	8	20				
	ORGANICS								

ICP = Inductively Coupled Plasma
GFAA = Carbon Furnace Atomic Absorption
GFAA = Graphite Furnace Atomic Absorption

4.4 Usability of Existing CDPHE Data

Upon review of the EPA HRS data requirements and the data previously collected by CDPHE, it seems that the Data Quality Objectives, sampling locations, sampling methods, analytical methods, required detection limits (except for lead) field and laboratory QA/QC measures and data validation requirements are comprable. Differences between what EPA would have included in a Site Investigation and what CDPHE has thusfar collected appear to be limited to:

1) analyses of Antimony, Barium, Beryllium, Cobalt, Potassium, Sodium, Thallium and Vanadium inorganic parameters;
2) analyses of organic parameters;
3) analyses of sediments (collocated with surface water) samples; and,
4) detection limits for lead (CDPHE = 5ug/L, whereas EPA = 3ug/L).

Sampling conducted in Cement Creek and the Upper Animas basins by Standard Metals and Sunnyside Gold Corporation between 1981 and 1993 reported the following concentrations of those metals (excluding cobalt) not sampled for by CDPHE (Perino, 1995):

Parameter Sampled	Cement Creek above the American Tunnel Concentrations reported in ug/L			Animas River above Boulder Creek Concentrations reported in ug/L		
	September 1986	September 1991	February 1993	September 1986	September 1991	February 1993
Antimony	< 10	0		< 10	0	
Barium	300	0		400	0	
Beryllium	1	2		< 1	0	
Thallium	< 100	0		< 100	0	
Vanadium			< 10			< 10

Water quality analyses of 89 water qualiy samples from 49 draining mine sites (aqueous sources) were collected and anlayzed by the U.S. Bureau of Mines as part of their field inventory of abandoned mine lands on Bureau of Land Management administered lands in the upper Animas River Watershed, conducted during the summer and fall of 1994 (U.S.BOM, 1995). Amongst other parameters analyzed, the range of concentrations for those metals not analyzed for by CDPHE, except antimony and thallium, follow (Hite, 1995):

Antimony:	not analyzed;	EPA CRDL = 60 ug/L
Barium:	< 2 - 97 ug/L;	EPA CRDL = 200 ug/L
Beryllium:	< 1 - 3 ug/L;	EPA CRDL = 5 ug/L
Cobalt:	< 3 - 16 ug/L;	EPA CRDL = 50 ug/L
Thallium:	not analyzed;	EPA CRDL = 10 ug/L
Vanadium:	< 6 - 6 ug/L;	EPA CRDL = 50 ug/L

The Colorado Department of Health conducted Site Investigations

of Standard Metal's Mayflower Mill (on the Animas River) and Sunnyside Mine (on Cement Creek) in June and July, 1984, respectively.

The following table presents the concentrations of antimony, barium, beryllium, cobalt, thallium and vanadium resulting from those investigations [CDH, 1984(a) and 1984(b)]:

TABLE V

CDH Site Investigation Anallyical Results - 1984
Standard Metals Mayflower Mill and Sunnyside Mine

Concentrations measured in micrograms per liter (ug/L)

Sample Number	Site Description	Antimony	Barium	Beryllium	Cobalt	Thallium	Vanadium
Animas River: Mayflower Mill SI							
SW-1	Background Boulder Cr. above Tailings (Silverton DW supply)	< 2	43	< .5	< 6	< 2	260
SW-2	Source Active Tailings	< 2	56	1	14	< 2	160
SW-3	Source Seepage from Toe of Tailings	9	89	2	37	< 2	150
SW-4	Source Lowest Clarifier Pond	6	70	1	14	< 2	140
SW-8	Downstream of Site on Animas River	3	38	5	22	< 2	110
Cement Creek: Sunnyside Mine SI							
SW-3	Background Cement Creek above Mine Drainage Treatment Settling Ponds	< 20	< 100	< 5	< 50	< 10	< 200
SW-1	Source Influent Pipe for Settling Pond #1 of 4	< 20	< 100	18	53	< 10	< 200
SW-2	Source Effluent form Settling Pond # 3 of 4	< 20	< 100	< 5	< 50	< 10	< 200
SW-4	Downstream of Site on Cement Creek	< 20	< 100	< 5	< 50	< 10	< 200

BOM, Sunnyside Gold and CDH (1984) analyses indicate that antimony, beryllium, and cobalt were below current EPA CLP Contract Required Detection Limts (CRDL). Sunnyside Gold measured barium in concentrations above current EPA CLP CRDL, whereas BOM and CDH (1984) analyses measured concentrations of barium below current EPA CRDL. Thallium was measured to be less than EPA CRDL by the CDH (1984) analyses, and beolow 100 ug/L by Sunnyside Gold. Vanadium was measured by Sunnyside Gold to be less than EPA CRDL, yet ranged in concentrations from 110-260 ug/L during the CDH SI of the Mayflower Mill.

Organic parameters are typically not associated with draining mine adits or mine waste piles, although may be utilized in and

around mineral transportation and processing facilities. Analyses for such may be included for select sites in additional sampling planned for by the Animas Stakeholders to determine the presence of these compounds, determining the need for additional organic parameter analyses.

Sampling of sediments provides information regarding historic releases of wastes that may not be detected in the real time results provided by one-time surface water sampling. CDPHE data, however, was collected during (two) high-flow, (one) low-flow and (one) rainstorm events, thereby characterizing the release of metals through time. CDPHE sampling results represent extremes of stream flows, as well as characterizing a storm runoff event, thereby bracketing the characterists of wastes released through time.

CDPHE also reviewed the ratio of dissolved to total recoverable metals for the Animas River, Cement Creek and Mineral Creek, as presented in Table VI. CDPHE explains that the partitioning of metals between the dissolved and total forms is largely a function of pH. High total suspended solids, found when surface runoff is present, may also increase the particulate fraction of a metal. Most iron and lead precipitate rapidly at pH's greater than 3. Precipitation of aluminum nears completion at pH's higher than about 4.5. Cadmium, manganese and zinc largely remain dissolved until pH's exceed 8. The pH of the Animas above Silverton (AG8) usually ranges between 7 and 8, thus most of the aluminum, copper, lead and iron should be expected in the particulate form, (more likely to precipitate into the sediments) while most of the cadmium, manganese, and zinc will be dissolved. The uniformly low pH of Cement Creek is expected to result in a wide mixture of particulate and dissolved metals, except cadmium, manganese and zinc which will be dissolved. The pH in Mineral Creek, M-34, is higly variable, depending on streamflow, which further complicates partitioning between dissolved and particulate forms of the metals, except again cadmium, manganese, and zinc, which are mainly dissolved (Owen, 1994).

TABLE VI

CDPHE ANIMAS RIVER LOADING RESULTS
RATIOS OF DISSOLVED TO TOTAL RECOVERABLE METALS
FOR THE ANIMAS RIVER, CEMENT CREEK AND MINERAL CREEK

Metals	ANIMAS RIVER			CEMENT CREEK			MINERAL CREEK		
	Mean	N	Standard Deviation	Mean	N	Standard Deviation	Mean	N	Standard Deviation
Aluminum				0.7	56	0.287			
Cadmium	0.9	44	0.161	0.93	86	0.163	1	40	0.068
Copper	0.56	44	0.231	0.87	79	0.19	0.57	41	0.276
Iron				0.46	66	0.291			
Lead				0.7	72	0.296			
Manganese	0.86	44	0.19	0.89	56	0.193	0.92	41	0.109
Zinc	0.99	45	0.141	0.94	83	0.127	0.96	42	0.099

Although sampling of sediments may not provide additional information concerning the parameters found elevated in the aqueous stream analyses, it may yeild information regarding historic releases of minerals not currently measured in the stream analyses, such as mercury. Collection and analyses of sediments may be included for select sites in additional sampling planned for by the Animas Stakeholders to determine the presence of elements not detected in the surface waters.